

**REMARKS**

Claims 1-3, 6, 7, 10-13, 16-19, 21-28, 30, 32, 33, 36-42, 44, 46-48, 50 and 53-93 are pending in the application.

Claims 21-28, 30, 32, 33, 36-42, 44, 46, 58, 69-74, 82, 83, 89 and 90 are allowed.

Claims 60, 61, 63-68, and 75-79 are objected to as being dependent upon a rejected base claim.

Claims 87-93 are objected to for alleged informalities. Claims 87-93 are amended as suggested by the Examiner, and therefore, this objection is rendered moot.

Claims 47, 53, 54-57, 84-85, and 91-92 stand rejected under 35 U.S.C. §102(e) as being anticipated by Ding et al (5,814,563). Claims 1-3, 6-7, 10-13, 16-19, 48, 50, 59 62, 80, 81, 86-88 and 93 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Ding et al (5,814,563) in view of Sahin et al (6,465,051).

Regarding the obviousness rejection against claim 1 based on the combination of Ding and Sahin, the Examiner is respectfully reminded that to establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. See, e.g., MPEP §2143 (8<sup>th</sup> ed., rev. 2).

The Federal Circuit discussed proper motivation *In re Lee*, 61 USPQ 2d 1430 (Fed. Cir. 2002). The motivation identified in the Office Action is akin to the conclusory statements set forth in *In re Lee* which were found to fail to provide the requisite motivation to support an obviousness rejection. The Court in *In re Lee* stated the factual inquiry whether to combine references must be thorough and searching. It must be based on objective evidence of record. The Court in *In re Fritch*, 23 USPQ 2d 1780, 1783 (Fed. Cir. 1992) stated motivation is provided only by showing some objective teaching in the prior art or that knowledge generally available to one of ordinary skill in the art would lead that individual to combine the relevant teachings of the references. The *Lee* Court stated that the Examiner's conclusory statements in the *Lee* case do not adequately address the issue of motivation to combine. The Court additionally stated that the factual question of motivation is material to patentability and can not be resolved on subjective belief and unknown authority. The Court also stated that deficiencies of cited references cannot be remedied by general conclusions about what is basic knowledge or common sense. The Court further stated that the determination of patentability must be based on evidence.

The Office on page 5 of the Action states that the combination is appropriate to perform a chamber clean operation and to remove absorbed fluorine atoms from the chamber interior. Applicants respectfully assert such is insufficient to support a proper *prima facie* rejection. For example, the record is void of any evidence that Ding is concerned with problems regarding cleaning of the chamber or removal of fluorine atoms to provide the necessary motivation to look to Sahin for meaningful teachings.

Further, even if Ding were concerned with or experiences such problems, there is no *objective evidence of record* that the cleaning chemistries of Sahin will work to clean the processing chamber of Ding or remove absorbed fluorine atoms if the Ding device is modified as alleged by the Office. The Office has failed to present objective evidence of record to combine the references and claim 1 is allowable for at least this reason.

Moreover, since Ding is completely devoid of any teaching that a chamber clean is needed and completely devoid to any teaching that absorbed fluorine atoms are adhering to the chamber interior, there is **no motivation to modify the Ding process chamber to do that which is not stated to be needed**. “Preferably the Examiner’s explanation should be such that it provides that impetus necessary to cause one skilled in the art to combine the teachings of the references to make the proposed modification.” *Ex Parte Levengood*, 28 USPQ2d, 1300, 1301, Footnote 2, (Bd. Pat. App. and Inter. 1993) (citations omitted). Without a teaching by Ding to needing a chamber cleaning or fluorine atoms removed, the Examiner has not met this test to provide the impetus necessary to cause one skilled in the art to combine the teachings of the references to make the proposed modification. Since an appropriate motivational rationale to combine reference teachings is required for an obviousness rejection, the obviousness rejection fails and should be withdrawn. Claim 1 is allowable.

Additionally, even if the references are combined, the combination fails to disclose or suggest positively recited limitations of claim 1. For example, claim 1 recites plasma etching forming a polymer comprising carbon and a halogen. The Examiner recites col. 4, Ins. 15-25; col. 6, Ins. 1-5; and col. 9, Ins. 4-6 as allegedly disclosing the

claimed composition of polymer. Applicants respectfully submit the teachings relied upon by the Office fail to disclose the claimed composition of the polymer.

More specifically, referring to the teachings in col. 4, Ins. 15-25 of Ding, Ding teaches etching contact holes 45 in a dielectric layer 20 forms a polymer 46 on sidewalls 48 of contact holes 45, as shown in Fig. 1b and 1d. However, this section of Ding does not teach or suggest **a composition of the polymer 46**, and therefore, could not possibly teach or suggest the claimed polymer comprising carbon and a halogen as positively recited in claim 1. Regarding the teachings at col. 6, Ins. 1-5 of Ding, Ding teaches a silicon dioxide layer is etched by a fluorohydrocarbon gas to form volatile  $\text{SiF}_x$  species that are exhausted from process chamber 50. A polymer is not mentioned once in this teaching of Ding, and therefore, this teaching of Ding provides absolutely no teaching to a *composition of polymer comprising carbon and a halogen as claimed*. Consequently, this teaching of Ding can not possibly teach or suggest the claimed polymer comprising carbon and a halogen as positively recited by claim 1. Regarding teachings at col. 9, Ins. 4-6 of Ding, Ding teaches adding carbon-oxygen gas to the etchant process gas results in the carbon-oxygen gas typically reacting with fluorine-containing species to form volatile  $\text{COF}_2$ , thereby reducing the fluorine concentration in the process chamber 50. These teachings are void of disclosing or suggesting the claimed polymer comprising carbon and a halogen. The following teachings of Ding, at col. 9, Ins. 8-14, teach the carbon-oxygen gas enhances formation of carbon and  $\text{CF}_2$  species that react with other species, such as nitrogen, fluorine, and boron to form polymer 46 on the sidewalls of contact openings 45. However, these

teachings of Ding do not teach or suggest the **composition** of polymer 46, only to what is reacted to form the polymer, and listing reactants does not teach what the final composition of the end product will be. These teachings of Ding fail to teach or suggest a polymer comprising carbon and a halogen as positively recited in claim 1. Accordingly, even if the prior art teachings are combined, the combination fails to teach or suggest positively recited limitations of claim 1 and claim 1 is allowable for at least this reason.

Claim 1 further recites forming polymer **over at least some internal surfaces of the plasma etch chamber**. The Office inappropriately relies upon the teaching in col. 10 of Ding as allegedly disclosing this claimed limitation. More specifically, his section of Ding (col. 10) summarizes that the entire disclosure of Ding is directed to an invention for plasma etching “dielectric layers 20 on semiconductor substrates 25, with high etch rates, and high etching selectivity ratios.” col. 10, Ins. 40-45. Such teachings generically relate to plasma etch chemistries and parameters to etch a dielectric layer and such teachings are devoid of any teachings to the claimed formation of the polymer over surfaces of the process chamber. Applicant has failed to uncover any teachings by Ding regarding forming a polymer on internal surfaces of a process chamber 50. Accordingly, even if the prior art teachings are combined, the combination fails to teach or suggest positively recited limitations of claim 1 and claim 1 is allowable for at least this reason.

Claim 1 further recites plasma etching the polymer from the chamber internal surfaces after the forming of the polymer. Of the combination of Ding and Sahin, the

Office relies on Ding to teach this positively recited limitation. However, with regard to the limitation of etching the polymer, Ding teaches only forming the polymer, and is completely devoid of teachings directed to processing the polymer after it is formed. Accordingly, the teachings identified by the Office fail to teach or suggest etching the polymer from the chamber internal surfaces as positively recited by claim 1. Claim 1 is allowable for at least this reason.

Claim 1 further recites a gas having a hydrogen component effective to form a gaseous hydrogen halide from halogen liberated from the polymer. That is, the polymer is being processed. Again, of the Ding and Sahin combination, the Examiner relies on col. 10 of Ding to teach the limitation. With regard to the limitations of the gas, Ding teaches only forming the polymer, and is completely devoid of teachings directed to processing the polymer after it is formed including the specifically claimed gas having the hydrogen component. Accordingly, the teachings identified by the Office fail to teach or suggest a gas having a hydrogen component *effective to form a gaseous hydrogen halide from halogen liberated from the polymer* as positively recited by claim 1. Claim 1 is allowable for this additional reason.

Claim 1 further recites wherein the **gas comprises O<sub>2</sub>**, and wherein the hydrogen component and O<sub>2</sub> are provided in the chamber during the plasma etching at a volumetric ratio of the one to the another of at least 0.1:1 of O<sub>2</sub> to the hydrogen component. Of the combination of Ding and Sahin, the Examiner states Ding teaches such limitation at col. 9, Ins. 23-25. However, this section of Ding teaches a volumetric flow ratio of carbon-oxygen gas to fluorohydrocarbon. That is, Ding teaches a ratio of

oxygen bonded with carbon to a hydrogen component, but not oxygen alone in a ratio to the hydrogen component. In fact, the Examiner subsequently admits in his action addressing other claims that Ding fails to disclose using oxygen gas in the plasma etching step (pg. 6 of paper no. 033105). Accordingly, the teachings identified by the Office fail to teach or suggest a ratio of the one to the another of at least 0.1:1 of O<sub>2</sub> to the hydrogen component as positively recited by claim 1. Claim 1 is allowable for this additional reason.

Claims 2-3, 6-7, 62-66, 80 and 87 depend from independent claim 1, and therefore, are allowable for the reasons discussed above with respect to the independent claim, as well as for their own recited features which are not shown or taught by the art of record.

For example, claim 62 recites O<sub>2</sub> is provided at a flow rate of 1000 sccm. The Examiner correctly states Ding fails to teach this limitation and relies on Sahin to allegedly teach the limitation. The Examiner relies on col. 7, Ins. 18-21 of Sahin which teaches 0.5 to 3 liters per minute of a fluorine-containing gas and oxygen is pumped into a chamber. However, this teaching is directed to providing a **volume of the combination** of fluorine-containing gas and oxygen, that is, the oxygen bonded with other components, and not the oxygen alone as a molecule (O<sub>2</sub>). Accordingly, Sahin does not teach or suggest O<sub>2</sub> is provided at a flow rate of 1000 sccm as positively recited by claim 62. The teachings identified by the Office fail to teach or suggest the positively recited limitation of claim 62. Claim 62 is allowable.

Still regarding the rejection against claim 62, a conversion for "sccm" is 1 torr-liter/sec = 79 sccm. Accordingly, the range of 0.5 to 3 liters per minute taught by Sahin is equivalent to 4 sccm or less. In no fair or reasonable interpretation does a teaching to 4 sccm or less teach or suggest 1000 sccm as positively recited by claim 62, and therefore, the positively recited limitation of claim 62 is allowable.

Regarding the rejection against independent claim 10 based on Ding and Sahin, even if the references are combined, the combination fails to disclose or suggest positively recited limitations of claim 10. Claim 10 recites a gas comprises an oxygen component forming an oxygen and carbon compound mixture, and wherein the carbon compound is provided at from about 5% to about 80% by volume of the oxygen and carbon compound mixture. The Examiner correctly states Ding fails to teach oxygen gas in the etching process and relies on the teaching of Sahin to col. 7, Ins. 18-21. This section of Sahin teaches 0.5 to 3 liters per minute of a fluorine-containing gas, for example CF<sub>4</sub>, and oxygen is pumped into a process chamber. However, this section of Sahin teaches a volumetric flow ratio of carbon, fluorine and oxygen in combination, but not carbon alone in a ratio relative to the oxygen component. Accordingly, Sahin does not teach or suggest the **carbon compound** is provided at from about 5% to about 80% by volume of the oxygen and carbon compound mixture as positively recited by claim 10. Accordingly, the teachings identified by the Office fail to teach or suggest the positively recited limitation of claim 10. Claim 10 is allowable.

Claim 10 further recites forming a polymer comprising carbon and a halogen. As demonstrated above, the teachings identified by the Office fail to teach or suggest a

*composition* of a polymer, and therefore, could not possibly teach or suggest a polymer comprising carbon and a halogen as positively recited in claim 10. For at least this reason, claim 10 is allowable. Claim 10 further recites forming a polymer over at least some internal surfaces of a plasma etch chamber. As demonstrated above, the teachings identified by the Office teach only forming a polymer over sidewalls of a dielectric layer, and not over internal surfaces of a chamber. Therefore, the teachings identified by the Office fail to teach or suggest forming a polymer over at least some internal surfaces of a plasma etch chamber as recited by claim 10. For at least this reason, claim 10 is allowable. Additionally, claim 10 recites using a gas comprising a carbon compound effective *to getter the halogen from the etched polymer*. As demonstrated above, the teachings identified by the Office teach only forming a polymer, and not processing of the polymer once the polymer is formed. Accordingly, the teachings identified by the Office fail to teach or suggest *to getter the halogen from the etched polymer* as positively recited in claim 10. For at least this reason, claim 10 is allowable.

Furthermore, the Examiner provides an inappropriate motivational rationale for the combination of Ding and Sahin as Ding does not teach a cleaning is needed for the process chamber 50, and therefore, no appropriate motivation is presented by the Office to modify the Ding process chamber 50. Therefore, the obviousness rejection is inappropriate and should be withdrawn. Claim 10 is allowable for at least reason.

Claims 11-13, 16-19, 67-68, 81 and 88 depend from independent claim 10, and therefore, are allowable for the reasons discussed above with respect to the

independent claim, as well as for their own recited features which are not shown or taught by the art of record.

Regarding the anticipation rejection against independent claim 47 based on Ding, such claim recites a polymer comprising carbon and fluorine. As demonstrated above, the teachings identified by the Office fail to teach or suggest a *composition* of a polymer, and therefore, could not possibly teach or suggest a polymer comprising carbon and fluorine as positively recited in claim 47. For at least this reason, claim 47 is allowable. Claim 47 further recites a polymer forming over at least some internal surfaces of the plasma etch chamber. As demonstrated above, the teachings identified by the Office only teach forming the polymer over sidewalls of a dielectric layer, **and not over internal surfaces of a chamber**. Therefore, the teachings identified by the Office fail to teach or suggest a polymer forming over at least some internal surfaces of the plasma etch chamber as recited by claim 47. For at least this reason, claim 47 is allowable. Additionally, claim 47 recites a gas effective to **etch polymer from chamber internal surfaces**, and forming HF during the second plasma etching from *fluorine liberated from the polymer* to restrict widening of the contact openings formed in the insulative oxide. As demonstrated above, the teachings identified by the Office teach only to form a polymer, and not processing of the polymer once the polymer is formed including the specific limitations of forming HF from fluorine liberated from the polymer to restrict widening of the contact openings. Accordingly, the teachings identified by the Office fail to teach or suggest *these* positively recited limitations of claim 47. For any one of these reasons individually, claim 47 is allowable.

Claims 48, 50, 53, 75-77, 84 and 91 depend from independent claim 47, and therefore, are allowable for the reasons discussed above with respect to the independent claim, as well as for their own recited features which are not shown or taught by the art of record.

Regarding the anticipation rejection against independent claim 54 based on Ding, such claim recites a polymer comprising carbon and fluorine. As demonstrated above, the teachings identified by the Office fail to teach or suggest a *composition* of a polymer, and therefore, could not possibly teach or suggest a polymer comprising carbon and fluorine as positively recited in claim 54. For at least this reason, claim 54 is allowable. Claim 54 further recites a polymer forming over at least some internal surfaces of the plasma etch chamber. As demonstrated above, the teachings identified by the Office only teach forming the polymer over sidewalls of a dielectric layer, **and not over internal surfaces of a chamber**. Therefore, the teachings identified by the Office fail to teach or suggest a polymer forming over at least some internal surfaces of the plasma etch chamber as recited by claim 54. For at least this reason, claim 54 is allowable. Additionally, claim 54 recites a gas effective to **etch polymer from chamber internal surfaces**, and *gettering fluorine liberated from the polymer during the second plasma etching* with the carbon component. As demonstrated above, the teachings identified by the Office teach only to form a polymer, and not processing of the polymer once the polymer is formed. Accordingly, the teachings identified by the Office fail to teach or suggest *these* positively recited limitations of claim 54. For any one of these reasons individually, claim 54 is allowable.

Claims 55-57, 78-79, 85 and 92 depend from independent claim 54, and therefore, are allowable for the reasons discussed above with respect to the independent claim, as well as for their own recited features which are not shown or taught by the art of record.

Regarding the obviousness rejection against independent claim 59 based on Ding and Sahin, even if the references are combined, the combination fails to disclose or suggest positively recited limitations of claim 59. Claim 59 recites a polymer comprising carbon and fluorine. As demonstrated above, the teachings identified by the Office fail to teach or suggest a *composition* of a polymer, and therefore, could not possibly teach or suggest a **polymer comprising carbon and fluorine** as positively recited in claim 59. For at least this reason, claim 59 is allowable. Claim 59 further recites a polymer forming over at least some internal surfaces of the plasma etch chamber. As demonstrated above, the teachings identified by the Office only teach forming the polymer over sidewalls of a dielectric layer, **and not over internal surfaces of a chamber**. Therefore, the teachings identified by the Office fail to teach or suggest a polymer forming over at least some internal surfaces of the plasma etch chamber as recited by claim 59. For at least this reason, claim 59 is allowable. Additionally, claim 59 recites a gas comprising O<sub>2</sub> effective to **etch polymer from chamber internal surfaces**, and *gettering fluorine liberated from the polymer during the second plasma etching* with the carbon component. As demonstrated above, the teachings identified by the Office teach only to form a polymer, and not processing of the polymer once the polymer is formed. Additionally, as demonstrated above, the teachings identified by the

Office do not teach O<sub>2</sub> to be included in a plasma etch chemistry. Accordingly, the teachings identified by the Office fail to teach or suggest a gas effective to **etch polymer from chamber internal surfaces**, and *gettering fluorine liberated from the polymer* as positively recited by claim 59. For any one of these reasons individually, claim 59 is allowable.

Additionally, claim 59 recites providing the O<sub>2</sub> and NH<sub>3</sub> in the plasma etch chamber at 1,000 sccm and 60 sccm, respectively. The Examiner correctly states Ding fails to teach oxygen gas in the etching process and relies on the teaching of Sahin to col. 7, Ins. 18-21 which teaches 0.5 to 3 liters per minute of a fluorine-containing gas and oxygen is pumped into a chamber. This teaching of Sahin does not teach or suggest NH<sub>3</sub>, and therefore, cannot possibly teach or suggest this limitation. Therefore, the teachings identified by the Office do not teach or suggest NH<sub>3</sub>, and for at least reason, claim 59 is allowable. Moreover, this section of Sahin teaches a volumetric flow ratio of a fluorine-containing gas, for example nitrogen, fluorine and oxygen in combination, but not oxygen alone (molecule O<sub>2</sub>) in a ratio relative to the NH<sub>3</sub>. Accordingly, teachings identified by the Office do not teach or suggest providing the O<sub>2</sub> and NH<sub>3</sub> in the plasma etch chamber at 1,000 sccm and 60 sccm, respectively as positively recited by claim 59. Claim 59 is allowable.

Still regarding the rejection against claim 59, a conversion for "sccm" is 1 torr-liter/sec = 79 sccm. Accordingly, the range of 0.5 to 3 liters per minute taught by Sahin is equivalent to 4 sccm or less. This range of 4 sccm or less can not possibly teach 1000 sccm as positively recited by claim 59, and therefore, it is inconceivable that the

range of Sahin teaches or suggests providing the O<sub>2</sub> in the plasma etch chamber at 1,000 sccm as positively recited by claim 59. Claim 59 is allowable. Furthermore, the Examiner provides an inappropriate motivational rationale for the combination of Ding and Sahin as Ding does not teach a cleaning is needed for the process chamber 50, and does not teach atoms are adhering to the process chamber 50, and therefore, no appropriate motivation is presented by the Office to modify the Ding process chamber 50. Additionally, the Office has failed to meet their burden of identifying objective evidence of record that the chemistries of Sahin are combinable with the chemistries of Ding to operably provide cleaning or removal of the atoms if the teachings are combined. Therefore, the obviousness rejection is inappropriate and should be withdrawn. Claim 59 is allowable for at least this reason.

Claims 60-61, 86 and 93 depend from independent claim 59, and therefore, are allowable for the reasons discussed above with respect to the independent claim, as well as for their own recited features which are not shown or taught by the art of record.

This application is now believed to be in immediate condition for allowance, and action to that end is respectfully requested. If the Examiner's next anticipated action is to be anything other than a Notice of Allowance, the undersigned respectfully requests a telephone interview prior to issuance of any such subsequent action.

Respectfully submitted,

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